15.

Food of the Bermuda and West Indian Tunas of the Genera *Parathunnus* and *Neothunnus*[1].

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(Plates I-III).

OUTLINE.

INTRODUCTION.

Although these grand game fish are so widely distributed, and in certain localities actually abundant, almost nothing of an accurate character has been published in regard to the food of any species of tuna[2]. In paper after paper we find that they are credited with feeding on "small fishes such as herrings, sardines and anchovies." Other authorities aver they subsist almost entirely on Copepoda and similar constituents of pelagic plankton. As a matter of fact, the above-mentioned fish enter hardly at all into their diet, while Copepoda is almost the only general group of crustaceans which we have never recorded from tuna stomachs.

This examination of the stomachs of tuna has developed varied and unexpected side lines of interest. We have found rare or quite new species of fish and invertebrates; from the food alone we have been able to learn much of the fish fauna of certain areas, especially in depths of one hundred to three hundred fathoms, off Bermuda, which are so obstructed with coral reefs that neither net nor dredge can be used. For example, we have found that *Holocentrus meeki* Bean (1906) is the immature stage of *H. ascensionis*. We know by the food at what depths the tuna have fed, and whether they have been swimming and feeding solitarily, in pairs or in schools.

My thanks are due to Mr. Martin D. Burkenroad of the Peabody Museum for the determination of decapods taken from the stomachs.

[1] Contribution from the Bermuda Biological Station for Research, Inc.
Contribution No. 502, Department of Tropical Research, New York Zoological Society.

[2] An exception is R. LeGendre's paper on the food of *Germo alalunga* (*Ann. Inst. Oceanogr. Paris*, 14, 1934, pp. 249 ff.).

Food of the Atlantic Black-finned Tuna, *Parathunnus atlanticus* (Lesson).

Part I.

Bermuda Notes.

Summarizing the food of 58 black-finned tunas taken in Bermuda during 1935 and 1936, we find that seven phyla are represented, Coelenterata, Nemathelminthes, Platyhelminthes, Annelida, Mollusca, Arthropoda and Chordata. The three general groups most abundantly and frequently represented are fish, young crustaceans (especially squilla larvae) and squids. Twenty-nine species of fish have been differentiated, not counting hopelessly mutilated individuals, which, if they could be identified, would easily double the number of forms. Of the 29, 13 have to date been specifically identified. Of the 58 stomachs examined, the majority contained both invertebrates and fish. Seven, or 12%, were empty.

The following list shows the general types of food contained in the stomachs:

Type of Food	*No. of stomachs in which it occurred.*
Sargassum weed	4
Siphonophores	1
Worms	6
Gastropods	3
Pteropods	5
Cephalopods	31
Squilla young	16
Shrimps	20
Amphipods, crabs, etc.	25
Isospondyls	2
Non-Isospondyls	54
Unknown fish	17

We can hardly consider the tunas as herbivorous, yet in four stomachs were such amounts of sargassum weed that there is no doubt it was swallowed intentionally. The single siphonophore may very well be put down as accidental, perhaps included when the squilla or the squid was swallowed. Worms, too, are negligible, most of them being parasitic stomach nematodes.

The pteropods are an interesting although relatively unimportant item of diet. Four species have been found, *Cavolinia, Creseis, Cuvierina* and *Limacina,* one each in four occurrences, so this is obviously a casual element of food. It illustrates, however, what we will find emphasized in other groups, that organisms of remarkably small size are deliberately chosen. The few, very small gastropods were young, free-swimming phases, not yet settled down to a bottom life.

For relatively large size and frequency of occurrence, squids were far ahead of any other group of invertebrates, and equalled only by the group of fishes as a whole. Squids were found in 30 stomachs or more than 60% of those which contained food, and they totalled 96 individuals. Some were pelagic forms found in the upper layers of the ocean, but a considerable percentage were luminous inhabitants of quarter-mile or greater depths.

The most universal food of tunas both of the Atlantic and the Pacific is the young of squillas or stomatopods. There is not the slightest doubt of the deliberate search for and choice of these organisms. They occur in 16 stomachs, nearly one-third of the whole, and to the number of 907 individuals. From these tuna records we may be certain that squilla larvae

occur usually in swarms. In 5 out of the 16 the average was something over 2 squillas to a fish, but in the remaining instances the average was over 80 squillas in each case. Many of these tunas had been feeding near the surface, yet No. 24,513 which had undoubtedly been procuring its nutriment a quarter-mile down, had devoured 60 squilla larvae.

The hyperid amphipods *Oxycephalus* and *Phronima*, the euphausiid *Thysanopoda*, megalops and young swimming crabs were present, but in small numbers and widely distributed throughout many stomachs. Other hyperid amphipods occurred 10 times, one fish having swallowed 55. Single specimens were taken of two peneids, one being the rare larva, *Cerataspis monstrosa*, and the other an adult male *Funchalia villosa*, the third male of its subgenus ever reported.

Carideans were usually rare, but a new species of *Leptochela* occurred six times, in large numbers in every case. We counted 24, 34, 161, 144, 27 and 39, all of them being adult. The interesting thing is that the first four lots were from tunas all taken in mid-September, 1935, from the same locality and at the same time, so that there must have been a tremendous swarming of the shrimp. When diving seven fathoms down near Gurnet's Rock, I have often seen great misty clouds of crustaceans, usually mysids. In cases like this, it would hardly seem possible for the tuna to seize the organisms one by one. The fish must swim through the swarm, snapping right and left, and, as with all the other elements of the food, swallowing the crustaceans whole. The two last lots of *Leptochela* were from fish equally closely associated in time and space, but taken on September 28. A species of *Palaemonella*, probably new, was present in two stomachs, and undescribed caridean post-larvae (Hippolytid?) occurred in three.

The fishes of the tuna food may, for convenience, be divided into three sections: first, the deep-sea element in tunas Nos. 24,512, 24,513 and 25,705; second, the fish which from September 4 to 28, 1935, are closely interlocked by their food; and third, all the other fish food. Considering these in reverse order, the third section includes scattered records of six fish used as food. A tuna taken July 18 had eaten a three-inch red-tailed triggerfish, *Xanthichthys ringens*, and a six-inch creolefish, *Paranthias furcifer*. September 14, a tuna caught well offshore had eaten three pomfrets, *Brama raii*, measuring little more than an inch each. October 9 we took an inchling trigger, *Monocanthus tuckeri*, from another tuna.

A butterflyfish, *Chaetodon*, only half an inch long, was among the food of a tuna taken in March, 1936. Four other tunas captured at this time, and within a short time of each other, had been feeding on anchovies, *Sardinella anchovia*. This quartet of tunas had eaten 55, 1, 2 and 16 respectively. The anchovy, unlike its relations, the pilchards and green fry, is rare close inshore at Bermuda, but very abundant offshore in mid-depths.

On September 4, 1935, my good friend and very skilful angler, Mrs. E. T. Weir, went out after tuna, and two miles southwest of Nonsuch Island sighted a large school leaping and playing about at the surface. A conservative estimate was about three hundred and they all appeared to be in the neighborhood of two feet long. Trawling back and forth, Mrs. Weir caught three and I found the food of this trio intensely interesting. They were the beginning of a series of seventeen, all interrelated through the similarity of their food, all taken in the three and a half weeks' time between September 4 and 28, 1935.

This general area from which they came is the almost unexplored zone which lies between the shallow Bermuda shore waters (where, down to fifty feet, we can walk about and observe by means of the diving helmet) and the outer abyssal depths, where the bottom, being of soft, relatively level ooze, is dredgeable. The prevalence of rough, jagged limestone covered with living coral makes the mid-zone wholly impossible for either trawling

net or dredge. In the old *Challenger* Reports of sixty-three years ago, we find that six soundings or dredges were made within this coral reef zone directly south of Nonsuch Island where the tuna are feeding today. We read of empty dredges or "in heaving in, the line carried away through chafing on hard ground." A short distance farther out, but still in the coral zone, at Station 33, the dredge came up unharmed with a catch so rich that the amazing fauna of this difficult ground was evident. The summary reads: "Excluding Protozoa, over 80 specimens of invertebrates were obtained at this station, belonging to about 70 species, of which 22 are new to science, including representatives of 3 new genera; 12 of the new species and 1 new genus were not obtained elsewhere." In addition to this list, 22 pteropods and heteropods, 152 Foraminifera and 83 diatoms were found. So the total for this one dredge haul was 337 species of organisms.

When I examined the stomach of the first of these tunas, I realized that the contents were alien to the shallow waters of Bermuda along shore, and yet had nothing in common with the fauna of the deeper, offshore areas. And I will here anticipate another discovery which was emphasized again and again, that these great fish had almost without exception been feeding close to the bottom. Somehow, I had never visualized these swift, pelagic beings as searching over, around and perhaps in the gorges and arches of the eroded limestone. But for that matter I had never thought to find such small, spiny organisms as squilla larvae dominant in their diet.

During the few nights preceding the first catch of these September tunas, we had as usual netted many fish attracted to our New Nonsuch wharf by the submerged and the ultra-violet lights. During this period we caught a number of the rarest squirrelfish known to Bermuda. The type of *Holocentrus meeki* was taken only three miles from our wharf, near St. David's Island thirty years ago. On Nonsuch Island, we had once captured an additional single specimen. Here were six taken in one evening, and in the stomach of the first tuna were no fewer than sixty of the same squirrelfish, in excellent condition. Pl. III, Fig. 5, shows fifty of these, so little affected by the gastric juices that even the colors were faintly evident. I was amazed to see this unexpected mass of exceedingly rare fish.

We kept several of those taken at the wharf alive in aquariums, and carefully watched them. Before our eyes, little by little, in the course of several weeks they changed from *Holocentrus meeki* to the common squirrelfish, *Holocentrus ascensionis*. The soft dorsal and anal fins increased in height, the depth of the body became greater, the greenish metallic tints gave place to rose and scarlet, and the abrupt, unlovely profile of the caudal peduncle slowly took form in our aquariums. There was no doubt about the fact that *meeki* is the immature stage of *ascensionis*. Large, brilliantly colored individuals of the latter species lived in cracks and crevices among the rocks about our wharf, but we had never before seen the young, and had no idea where they bred. Even in their habits and actions as well as in physical attributes the younger ones were unlike the adults. They kept in mid-water, well above the bottom, and were extremely wary, dashing here and there, often pursued and driven off by our wharf's habitués, their elder brethren.

There is another less common species of squirrelfish, the black-barred, *Holocentrus vexillarius*, slightly deeper in the body, darker in shade, with fewer dorsal spines and rays and only about half as many gill-rakers as the common form. There is also the very lovely, lesser butterflyfish, *Chaetodon sedentarius*, which we count as a rare fish in Bermuda, in comparison with three other species of the same genus. With this fore-knowledge of these three forms in mind, let us prepare a table of the food of our seventeen tunas, all taken within the period of two weeks, one to two miles off Nonsuch, and see what we can learn from it (Table I).

TABLE I.

Food of Bermuda specimens of *Parathunnus atlanticus* taken in September.

Tuna No.	17	18	19	23	24	25	26	27	34	35	36	37	38	39	40	41	42	Total
September	4	4	4	12	12	12	12	21	27	27	27	28	28	28	28	28	28	
Sargassum weed	...	...	...	...	...	...	...	...	...	...	...	...	1	1	...	...	...	
Holocentrus ascensionis	60	66	14	18	4	2	1	44	13	3	2	52	...	...	...	...	...	277
Holocentrus vexillarius	3	4	1	...	...	...	...	...	...	...	8	1	64	71	80	73	87	392
Chaetodon sedentarius	1	...	1	...	...	...	...	...	...	1	2	3	2	1	18	18	5	52
Leptochela sp. nov	...	...	...	...	...	24	34	161	144	...	...	...	...	...	27	39	...	429
Squids	1	4	3	1	...	...	...	7	4	10	...	...	...	...	...	2	2	34
Squilla yg	...	33	12	...	...	210	...	...	...	65	...	...	...	71	...	...	...	391
Serranid	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	
Parrotfish	...	...	...	...	...	...	...	...	...	...	2	...	...	...	...	...	...	
Wrasse, incl. 1 *Xyrichthys*	...	...	...	...	...	...	...	...	...	...	4	...	...	...	...	...	...	
Exonautes rubescens	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	
Melanostomiatid-like fish	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	
Flounder (*Etropus?*)	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	
Acanthurus sp	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	
Creseis	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	
Limacina	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	
Yg. Gastropods	...	...	...	...	...	...	...	2	...	...	...	...	...	...	...	...	...	
Oxycephalus	...	...	...	...	...	...	...	1	1	...	...	...	...	...	...	...	...	
Hyperids	...	...	...	...	...	...	...	5	...	...	...	...	...	...	1	...	...	
Glaucothoe yg	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	
Palaemonella sp. nov?	...	...	...	...	...	...	...	...	...	...	...	...	...	...	4	2	...	
Caridean yg. (Hippolytid?)	...	...	...	...	...	...	...	...	...	2	...	...	...	...	1	...	1	
Megalops	...	...	1	...	...	...	...	...	...	...	...	...	...	...	2	...	2	

Let us consider first the common squirrelfish, *H. ascensionis* (which for a time we thought was *H. meeki*). We find that it forms a large proportion of the food of the first twelve tunas, extending over the entire period of three and a half weeks. Although there are two tunaless intervals during this time, one of a week and the other of ten days, yet the supply of young squirrelfish never diminished. From a single individual to as many as 66 occur in a single stomach, the average eaten by each fish being 23. Here is a total of 277 squirrelfish, all of exactly the same stage of growth, all measuring two and a half inches in length (Fig. 5).

This paper purports to be concerned with consideration of the direct elements of food of tunas, but before we leave this species of *Holocentrus*, I want to carry them on to the indirect victualization of these fishes. I select three young squirrelfish at random from among the 60 in the first tuna's stomach and, in turn, examine their stomachs.

Stomachs of *H. ascensionis*

	A.	B.	C.
Candacia aethiopica	15	21	153
Other copepods	7	5	6
Ostracods	6	..	..
Euphausiids	..	1	..
Shrimps	..	2	..
Zoeas	8	6	7

Here in three out of 60 ingested fish were 237 organisms in perfect condition, giving a still more intensive visualization of the life of the

isolated mid-zone. And in the stomachs of several of the *Candacia* were radiolarians and diatoms, and so *ad infinitum*. This gives at least a more vital conception as to what means we must resort if we are ever to get farther in the study of these relatively inaccessible regions, than through conventionally usual methods of direct observation.

The stomachal distribution of the black-barred squirrelfish, *H. vexillarius*, is enlightening. The first three tuna had caught 3, 4 and 1 respectively, showing that these fish were about on September 4, after which not an individual appeared until 23 days had passed, when a tuna dined off both species. If we had had only this one fish, the significance of the reappearance of *vexillarius* would not have been apparent, but the following day and the same place yielded six tuna which were filled to repletion with *vexillarius*, while *ascensionis*, except for one fish, vanished forever from the diet, although they kept coming in small numbers to the night lights at our wharf. In the 5 tunas which had eaten only *vexillarius* were 375 individuals, an average of 75 squirrelfish to a tuna.

Like *vexillarius*, one or two of the rare butterflyfish, *Chaetodon sedentarius*, were found and devoured on September 4, and then reappeared on the 27th. On this and the following day, they must have been far from rare around the deep coral reefs of the tunas' feeding grounds, for 52 were divided among 8 tunas, two of which had found and accounted for 18 each. These butterflyfish will not take a hook, however small, and no trap can be lowered and recovered in these waters, so were it not for the tuna gourmands we should never have known of their abundance anywhere near Bermuda. Chaetodonts are essentially reef fish, swimming in and out among the branches and fans, and the young especially are never found far from shelter. Yet there were a half hundred youngsters, none over an inch in length, fallen victims to fish which, according to our preconceptions, should find their living in swift pursuit of organisms in mid- and upper zones.

Additional evidence of the frequent bottom feeding of tunas is found in one captured on September 27, which, in addition to both species of squirrelfish and chaetodonts, had included 4 wrasse and 2 parrotfish in its diet.

I have already spoken in general of squids, squilla larvae and carideans, and in the present consideration it is necessary only to look at the chart to see how the relation of these organisms to other food elements holds good for these 17 as for the entire 58 tunas. Thirty-four squids were eaten by 9 of the 17 tunas, with an average of less than 4 each; 391 squilla larvae were found in the coral zone by 5 tunas, each averaging 78; and specimens of the new *Leptochela*, as I have already mentioned, were present to the number of 429. Other items of diet of the 17 fish were negligible, but the food of tuna Number 27, taken on September 12, stands out by itself. The fish was captured in company with four of its fellows and like them had found *H. ascensionis* eminently to its taste, having pursued and captured 44, which if laid end to end would extend a distance of ten feet! These were, however, packed, sardine-wise, side by side within the tuna. With them were 13 other organisms of especial significance. These included two species of pteropods, an *Oxycephalus*, a small Melanostomiatid-like fish and a young free-swimming flounder. These and a few others come to the surface of the ocean at night, but in the day are found relatively deep and well offshore. So this individual fish must have done part of its feeding by itself and farther down and out at sea, or the night before. The fresh condition of the food indicated the former course as the more probable one. One more link with the habitat of the young squirrelfish and the butterflyfish was a single surgeon fish in its food.

On August 7, 1935, Mr. Christianson brought us two tunas, caught almost simultaneously, three miles southeast of Nonsuch Island. This is be-

yond the shallow, coral-lined waters of the coastal area, and over the abyssal depths of the deep open sea itself. Tuna are so often seen and taken in pairs that it appears reasonable to assume a definite relation between the two. In this case the male weighed sixteen pounds and the female twelve. They were typical black-finned tuna.

Although they were caught at the surface with white feather jigs, the first glance at the food showed that very recently they had been feeding at great depths. The food was quite fresh and the tuna must have come to the surface with a rush and immediately seized the feather jigs, far above their zone of feeding. Between them, these tuna had eaten thirty deep-sea fish, some quite new, others exceedingly rare, and several of the world's record size. In addition they had swallowed a dozen luminous squids and more than three score other creatures of the black abysses. The light organs of all were plainly visible, together with the typical scarlet and black coloration of inhabitants of the sunless depths. None of these hundred-odd organisms would ever, of its own free will, have risen even into the dimly-lighted regions of mid-water. The average depth at which they thrive, and must have been caught and devoured, is a half mile or more below the surface.

I submit photographs of the contents of these two stomachs as the contents were removed and roughly sorted, and opposite each of these two figures are two others showing the accurate restorations of every item of diet. In Pl. I, Fig. 2, we see at the top 23 lanternfish, *Diaphus effulgens*, then an oval-bodied pomfret or *Brama raii*, and to the left an unknown, short-toothed, gempylid-like fish. Below is a fierce-looking *Alepisaurus* or lancet-fish with a gigantic sail-fin. Next come two sabre-toothed *Omosudis lowii*, the larger a world's record for size (180 mm.). Near the bottom are three silver hatchetfish, *Argyropelecus aculeatus*, and scattered about we count 9 squid covered with luminous organs of various colors.

The second plate of reconstruction (Pl. II, Fig. 4) shows what the female tuna had for dinner on this particular seventh of August, and proves that she must have eaten at the same level and time as her mate. There are fewer lanternfish, in fact only three, and these are of a different species, *Diaphus rafinesquei*, and we counted 60 larval squillas. This tuna had also devoured exceedingly rare deep-sea fish. At the top is a new species, gempylid-like, with saw teeth; then two most interesting members of the family Trichiuridae or cutlassfish, a family wholly new to Bermuda which we have never taken in any of our fifteen hundred nets. The name of this fish, brought to us from a great depth by the tuna, is *Benthodesmus atlanticus*.

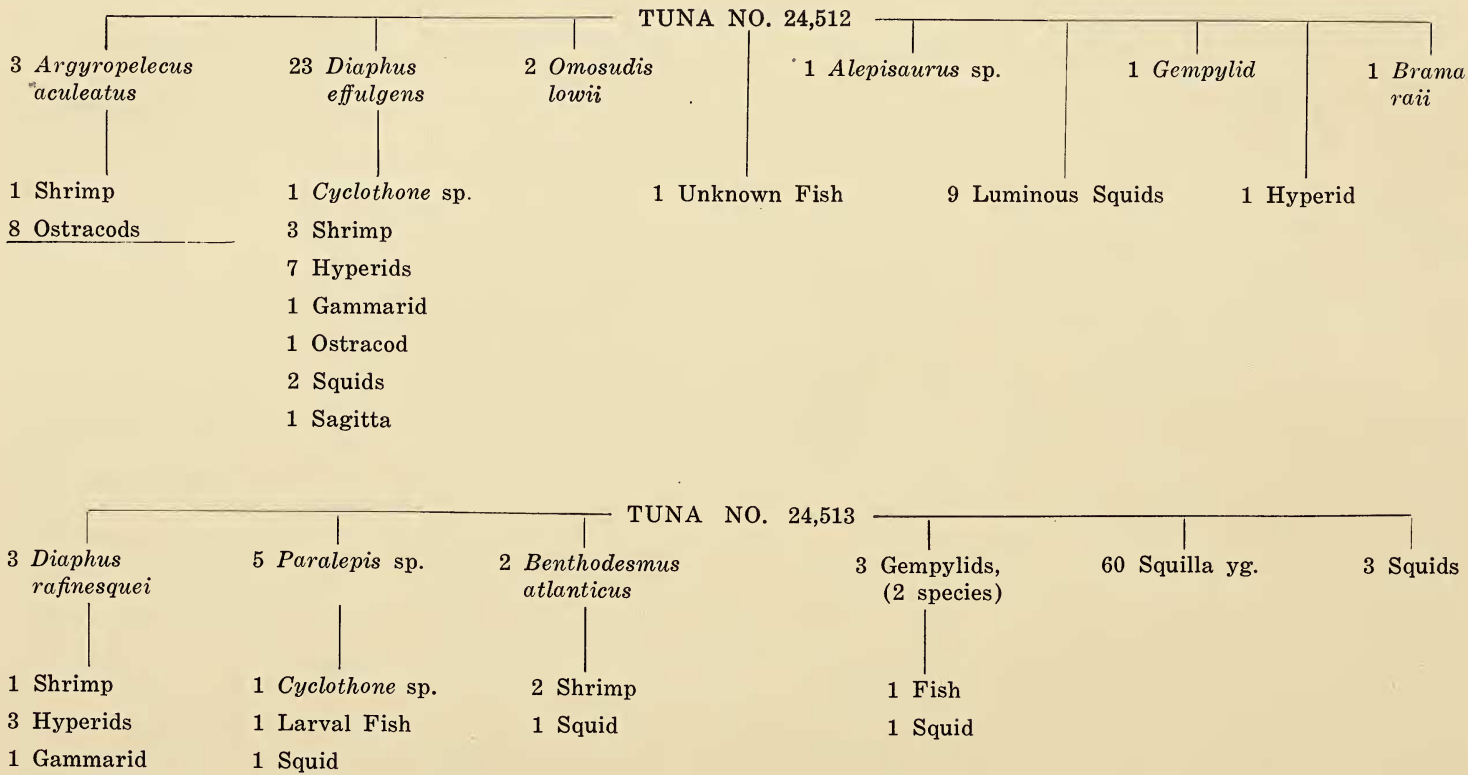
Below these are five individuals of a probably new species of *Paralepis* or ocean pikelet. Finally there are three luminous shrimps which were in the stomach of this tuna. The relative sizes are indicated on the figures. These deep-sea fish are larger than any fish which we have found in tunas feeding at higher levels.

Table II shows, in diagrammatic form, the direct and indirect food of these two deep-feeding tuna.

The stomach of the third and remaining tuna which showed indubitable evidence of having fed, in part, at a considerable depth was sent to us through the courtesy of Mr. Robert Blackman. It was caught near Bermuda early in the spring of 1936, and contained the following organisms: one 170 mm. *Avocettina infans*, which is one of the rarest deep-sea eels; two specimens of the lanternfish, *Myctophum hygomi;* one *Sardinella anchovia;* two squids, one of which had light organs; and one squilla larva.

TABLE II.

Direct and indirect food of two specimens of *Parathunnus atlanticus*.



Part II.

Florida Notes.

The data from this region is very scanty and refers to only two individual *Parathunnus atlanticus*, kindly sent me by Mr. Frederick Church. Both were found in the stomach of a Blue Marlin, *Makaira nigricans ampla* (Poey), which was more than ten feet long and weighed 304 pounds. The tuna weighed respectively 7 and 4 pounds. The former had eaten a single *Sardinella* of 55 mm. The second tuna ran true to form and though there were only two small organisms in its stomach, they were both squilla larvae.

Part III.

St. Lucia and Tobago Notes.

A pair of tuna taken at St. Lucia and 20 at Tobago show such similar stomach contents that I am considering them together. In our work at St. Lucia we have to thank Major William Lambert for many courtesies.

A number of leaves of some tropical tree found in one fish is the sum total of vegetable elements. Nine groups of invertebrates are present, of which only three are dominant; megalops with a total of 114 in 15 tunas, 308 squilla larvae in 19 stomachs, and 43 squids eaten by 7 individuals. Eleven genera of fish were identified in 11 tuna, besides many other small ones not yet named. All occur singly or not more than 4 to a stomach except *Anchoviella* (18), *Polynemus virginicus* (10), *Monocanthus* (12) and puffers (8). The others are *Harengula, Hemirhamphus, Fistularia serrata, Jenkinsia, Decapterus macarellus, Selene vomer* and *Lactophrys*. Except for the *Decapterus*, which was 6 inches long, all are two inches or under, and the majority are an inch or less. Their spiny character and almost wholly bottom habitat are also evident.

We once recorded *Rhomboplites aurorubens* from the stomach of a tuna taken near Haiti.

Food of the Atlantic Yellow-finned Tuna, *Neothunnus argentivittatus* (Cuv. and Val.).

As far as I know there has been no attempt at recording any details with regard to the food of this important commercial and game fish. The appended table presents a list of the stomach contents of eight individuals, one from Bermuda and seven from St. Lucia, the latter taken in the Channel between that island and Martinique. The Bermuda yellow-fin had swallowed only a few fresh fronds of Sargassum weed, and, strangely enough, leaves and bark were found in the stomachs of two of the others.

Squids were found in five out of the seven St. Lucia specimens. Ten species of fish have been identified and those which remain unknown would about double this number. *Oxyporhamphus* is an interesting primitive form of flyingfish with very small pectorals, and was unquestionably caught near the surface, while *Gonostoma*, the only representative of a deep-sea family found in the food of the yellow-fins, was probably swallowed several hundred fathoms down.

St. Lucia yellow-finned tuna No. 24,689 had the most interesting food. The invertebrate proportion was negligible, consisting of a single squid mandible, and 9 megalops. The fish totalled 58 individuals of at least 6 species, and comprising 4 puffers, 1 leathery filefish, 1 red-tailed triggerfish, 9 unidentified triggers and 42 flying gurnards. The average length of the puffers is 81 mm., of the triggerfish 31 mm., and of the two score gurnards 45 mm.

A general survey of the food of this individual reveals several unusual facts which are characteristic of tunas of several species, both in the Atlantic and Pacific Oceans. Here is a fish almost six feet in length (1,450 mm.) with a correspondingly good-sized mouth, yet which has chosen to swallow 58 fish averaging barely two inches in length. Also it would be difficult to choose a lot of fish less appetizing than these puffers, triggers, turbots and gurnards. They epitomize spininess in respect to skin, opercles and fin elements, and correlated with this supposedly protective armor the actual flesh and muscle necessary for swift movement are much less developed than in more ordinary fish.

This choice must be deliberate when we consider the amazing speed of these tunas, the ample size of their mouths and the abundance of smooth-skinned, thick-fleshed fish of all sizes. The swift-moving white feather jig would seem to have nothing in common with triggers, puffers and squilla larvae, yet this white surface lure is pursued and seized with eagerness and ease. Among the spiny organisms which dominated the tunas' diet were squillas, euphausiids, shrimps, megalops, *Hyporhamphus*, *Oxyporhamphus*, *Holocentrus*, *Cephalacanthus*, *Xanthichthys*, *Balistes*, and *Monacanthus*, while squids were the only smooth-skinned creatures of any numerical importance (Table III).

TABLE III.

Food of yellow-finned tuna: *Neothunnus argentivittatus.*

Cat. No. of Tuna	24,682	24,683	24,689	24,690	24,691	....	....	25,206
Place	St. Lucia	St. Lucia	St. Lucia	St. Lucia	St. Lucia	St. Lucia	St. Lucia	Bermuda
Length	645	690	1450	1360	....	....	....	555
Weight	12	16	140	....	....	....	....	8
Sex	Male	Male	Male	Male	Male	....	....	Male
Sargassum Weed	....	....	....	....	....	....	....	Few fronds
Leaf	....	1	....	....	....	....	....	....
Bark	....	....	1	....	....	....	....	....
Squid	....	....	1	5	5	2	6	....
Squilla larvae	2	26	....	2	....	....	....	....
Euphausiids	....	3	....	....	....	....	....	....
Shrimps	....	....	....	....	1	....	....	....
Megalops	....	....	9	55	1	....	....	....
Sardinella anchovia	....	....	....	....	....	....	1	....
Gonostoma sp.	....	....	....	....	2	....	....	....
Hyporhamphus unifasciatus	....	....	1	....	....	....	....	....
Oxyporhamphus micropterus	....	....	....	1	....	....	....	....
Holocentrus ascensionis	....	....	....	1	....	4	10	....
Decapterus macerellus	....	1	....	....	1	....	....	....
Cephalacanthus volitans	....	....	42	2	....	....	....	....
Xanthichthys ringens	....	....	1	....	....	....	....	....
Balistes forcipatus	....	....	1	....	....	....	....	....
Monacanthus hispidus	....	....	1	....	....	....	....	....
Sphaeroides spengleri	....	....	4	....	....	....	....	....
Unknown flying fish	....	....	....	....	....	1	....	....
Unknown triggerfish	....	....	9	1	....	....	....	....
Unknown fish	2	....	....	1	8	1	2	....

EXPLANATION OF THE PLATES.

Plate I.

Fig. 1. Contents of the stomach of a 16 pound male, black-finned tuna, *Parathunnus atlanticus*, Catalogue No. 24,512, taken at the surface south of Nonsuch Island, Bermuda, August 7, 1935. Both the fish and the invertebrates are deep-sea forms, relatively fresh and quite recognizable.

Fig. 2. Restoration of the deep-sea fish and invertebrate tuna food shown in Fig. 1. There are 42 organisms including 23 *Diaphus refulgens*, 1 *Brama raii*, 1 short-toothed gempylid, 1 *Alepisaurus* sp., 2 *Omosudis lowii*, 3 *Argyropelecus aculeatus*, 1 unidentified triangular-toothed fish, 1 hyperid amphipod and 9 luminous squid. (Drawing by George Swanson).

Plate II.

Fig. 3. Contents of the stomach of a 12 pound female *Parathunnus atlanticus*, Catalogue No. 24,513, taken at the same time and place as No. 24,512.

Fig. 4. Restoration of the deep-sea food of the female tuna shown in Fig. 3. Sixty-seven abyssal organisms including 1 saw-toothed gempylid, 2 *Benthodesmus atlanticus*, 2 short-toothed gempylids, 5 *Paralepis* sp., 3 *Diaphus rafinesquei*, 3 luminous squids, 51 squilla larvae. (Drawing by George Swanson).

Plate III.

Fig. 5. Fifty out of 60 squirrelfish, *Holocentrus ascensionis*, taken from stomach of black-finned tuna, *Parathunnus atlanticus*, Catalogue No. 24,558.